

Firearm Violence Among Youth: Public Health Strategies for Prevention

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Firearm violence is a serious threat to the health of our children: an American child dies of gunshot wounds every 1½ hours, and every 2 days 30 children—the equivalent of a school classroom—lose their lives to guns.¹ Injured children and adolescents are cared for in emergency departments and trauma centers, and in some urban areas the increasing incidence of firearm injuries threatens to overwhelm the trauma care delivery system. Because of the prevalence and enormous cost of firearm violence it has been identified as an epidemic and a public health emergency. In this article we discuss the burden of firearm injury and its effect on children and young adults, and we outline a public health approach to firearm injury prevention.

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SCOPE OF THE PROBLEM

The National Center for Health Statistics compiles information on violent injury deaths related to firearms. These analyses indicate that for all ages, the number of firearm deaths increased by 60% from 1968 through 1991 to 38,317.² Provisional data are available for more recent years; it is estimated that approximately 38,000 Americans were killed by firearms in 1993 and the same number in 1994.³ As a cause of fatal injury in the United States, guns rank second only to motor vehicles. In our cities, in seven states, and in the District of Columbia the rate of firearm-related deaths equals or surpasses that of deaths from motor vehicle crashes.^{2,4}

In 1992, 5,367 children and adolescents aged 1 to 19 years were killed by firearms (Table 1). Sixty-three percent were the victims of homicides, 27% of suicides, and 9% of unintentional injuries (what were once called accidents). In contrast, among adults aged 35 to 44 years, deaths from firearm homicides and suicides occur at similar rates, and in those older than 45 years old, firearm deaths from

suicide outnumber those from homicide.⁵ Minority youth are disproportionately affected by firearm homicides. Among children aged 10 to 14 years in 1992, the firearm homicide rate among black boys was more than five times the rate for white boys, and the firearm homicide rate for black girls was approximately six times the rate for white girls (Table 2). Among black males aged 15 to 19 years, firearm homicide rates were nine times those of white males (119.7 and 13.1 per 100,000, respectively); the rate for black females was more than four times the rate for white females (10.5 and 2.3 per 100,000, respectively). (Because Table 1 includes all races, the age group totals in Table 1 exceed those in Table 2.)

Suicide is the third leading cause of death among all adolescents aged 15 to 19 years, behind unintentional injuries (such as motor vehicle crashes) and homicides.⁶ Among black males, deaths from firearm homicides far exceed those from suicide; among white males, the firearm homicide and suicide rates are similar (13.1 and 12.8 per 100,000 population, respectively, in 1992). Black and white females had lower firearm suicide rates than did males. This epidemic of fatal violence is directly related to firearms. From 1985 to 1990, the rate of non-firearm-related homicide increased by 11% among 15- to 19-year-olds; the rate of firearm-related homicide increased by more than 100%. Among black males, the number of fatal firearm homicides increased by 280% and that of suicides increased by 60%. For white males (15 to 19 years old) the homicide rate doubled and the suicide rate increased by 25%.⁷

Firearm-related deaths have become a problem among the youngest teens: For all youths aged 10 to 14 years the firearm death rate increased by 18% from 1985 to 1990; for black males, the firearm death rate doubled.^{7,8}

The data suggest that teens are as likely to be killed by someone they know as by a stranger: crime records indicate that approximately half of homicide victims aged 15 to 24 years are killed by someone they know.⁹

Individuals who die of firearm injuries are only the tip of the firearm-injury iceberg. Current population-based information about nonfatal firearm injuries has only recently become available: In the 1-year period ending in May 1993, an estimated 99,000 persons in the United States were treated in emergency departments for nonfatal firearm-related injuries.¹⁰

Like adolescents killed with firearms, adolescents injured with firearms often know their assailants: one series reported that 56% were shot by a friend, acquaintance, or family member.¹¹

Psychologic morbidity results from injuries to children and teens and to those close to them. The firearm injury epidemic has produced a generation of young people who are growing up in fear of being shot. Each year, thousands of children are injured by firearms or directly touched by violence: the 38,000 Americans killed annually have children, nieces and nephews, and young friends and neighbors. A poll of US children in grades 6 to 12 reported that 40% of children said, "The threat of violence 'has made me change where I go, where I stop on the street, where I go out at night, what neighborhoods I walk in, who I make friends with, and other things like that.'" Fifty-seven percent were worried about someone carrying a gun and 37% were concerned they would be physically attacked.¹²

In addition to social and emotional costs, firearm injuries create health care costs for both acute and chronic care. In 1991, the average cost of hospitalization for children and adolescents with a firearm injury at an acute care children's hospital was more than \$14,000.¹³ It is estimated that in 1992 firearm injuries cost the United States \$20 billion dollars; more than three fourths of these costs are paid by taxpayers.¹⁴

The current level of firearm violence is a public health emergency unique to the United States (Figure 1). Comparisons of industrialized countries show that the US homicide rate among males aged 15 to 24 years is four times the rate in the second-ranked country. Most other developed countries had homicide rates 10 times lower than that in the United States. In the United States, three quarters of homicides resulted from the use of firearms. In the other countries, fewer than one fourth of the homicides were firearm related.¹⁵ These international data imply that youth firearm homicide can be prevented.

The availability of handguns has been shown to be strongly correlated with firearm mortality nationally and internationally: the correlation between household guns and suicide was .94 and that between household guns and homicide .75.^{16,17} US firearm deaths are disproportion-

Table 1.

US firearm deaths in 1992, ages 1-19 years.

Age (Years)	Homicide	Suicide	Unintentional	All*
1-4	69	0	35	105
5-9	56	3	48	111
10-14	348	172	132	667
15-19	2,878	1,251	285	4,484
Total	3,351	1,426	500	5,367

*Includes "intent unknown."

ately due to handguns (as opposed to rifles and shotguns).¹⁸ It is therefore reasonable to conclude that restricted access to handguns would likely decrease the number of violent-injury deaths.

Handguns appear to be the agent of this US health epidemic. In epidemiologic research there are well established guidelines for assessing causes (the role of the handgun) of violent death and disability. Aspects of association must be systematically evaluated before causation may be inferred.¹⁹

The strength, or size of the association between homicide or suicide and firearms has been shown: firearms are more deadly than other weapons, a handgun in the home increased the risk of homicide, and handguns are more prevalent in the homes of suicide victims.²⁰⁻²⁴ Consistency implies an association that has been observed by different persons in different places, circumstances, and times. Associations between homicide/assault, suicide, and unintentional firearm injuries and firearms have been observed under multiple differing conditions.^{15,25-36} Specificity concerns the association between the environmental factor and a specific way of dying; data indicate firearms are not associated with nonfirearm homicides or suicides.^{17,21,22,24,37,38} Temporality implies that exposure to the firearm precedes the development of increased risk for violent death and injury: investigation supports

this.^{24,38,39} A biologic gradient, or increasing risk with increasing exposure, has been shown for firearms and suicides or unintentional injuries or both.^{16,17,40,41}

Criteria concerning plausibility^{24,26,42-48}, coherence^{49,50}, experimental or quasi-experimental evidence^{17,22,37,38,51}, and analogy⁵²⁻⁵⁵ for other causes of disease are also supported by investigation concerning the role of handguns in violent death and injury. This review makes it clear that medical literature supports the idea that handguns meet epidemiologic criteria for a cause of environmental death.

PUBLIC HEALTH APPROACH

The need clearly exists to reduce the firearm death and injury rate in the United States. Criminal justice has been the traditional approach to controlling violence in this country. Increasing rates of violent injury make it clear that additional approaches will be needed to control this epidemic. The public health model, first developed and used to control infectious disease, has been successful in reducing nonviolent injury. Increasingly this model is being applied to violent injury as well.

Some core public health concepts are (1) prevention is preferable to treatment, (2) alterations in the environment are more likely to be effective than attempts to change individual behaviors, and (3) multiple strategies directed

Table 2.

US firearm deaths by sex and race, per 100,000 population.

Age (Years)	No. of Homicides (Rate)	No. of Suicides (Rate)	No. Unintentional (Rate)	All (Rate)*
1-4				
Black males	22 (1.8)	0	12†	34 (2.7)
White males	17	0	9	26 (.4)
Black females	19	0	2	21 (1.7)
White females	10	9	12	23 (.4)
5-9				
Black males	17	1	17	37 (2.6)
White males	21 (.3)	1	21 (.3)	43 (.6)
Black females	6	0	3	8
White females	10	1	6	18
10-14				
Black males	119 (8.4)	17	22 (.6)	163 (11.6)
White males	122 (1.6)	114 (1.5)	90 (1.2)	334 (4.5)
Black females	47 (3.4)	2	4	54 (3.9)
White females	42 (.6)	34 (.5)	12	89 (1.3)
15-19				
Black males	1,601 (119.7)	168 (12.6)	90 (6.7)	1,866 (141.0)
White males	917 (13.1)	901 (12.8)	168 (2.4)	2,025 (28.8)
Black females	137 (10.5)	17	7	162 (12.4)
White females	155 (2.3)	114 (1.7)	12	283 (4.3)

*Includes "intent unknown."

†Rate not shown when based on fewer than 20 deaths.

toward different risk factors are necessary solve the problem. These principles can be used to structure programs to prevent firearm deaths and injuries.

Public health approaches integrate efforts by diverse scientific disciplines and community leaders to address different facets of a problem, shifting focus from reacting to violence to addressing its causes. Some of these are "root causes," which are social, environmental, or behavioral in origin. They include racism, poverty, crowded housing, weak family structure, poor schools, anger and poor impulse control, alcohol and drug use and many other factors. It is important—and terribly difficult—to control all of these root causes of violence.

Fewer factors affect the severity and lethality of violent injury: guns are more likely to kill than any other weapon used in an assault.⁵⁶ Even if the number of violent events remained unchanged, reduced access to handguns would decrease the lethality of violence, resulting in fewer deaths and serious injuries. Thus efforts to reduce the numbers of deaths and injuries from firearms must focus on the firearms themselves, as well as on the root causes of violence.

The public health model is detailed in Figure 2. Step 1 is to define the problem. Step 2 is to identify associated risk factors and causes of the problem. Step 3 is to develop interventions and test their usefulness. Step 4 involves implementing interventions in the community by means

of specific programs and testing the effectiveness of these interventions.⁵⁷ Research and critical evaluation are crucial to the success of this model. We will discuss each step and suggest ways to apply this approach to prevent violent injury.

Efforts have been started to define the problem of violent injury. The National Center for Health Statistics tracks firearm- and non-firearm-related homicides and suicides. Only recently have national estimates of nonfatal firearm-related injuries been reported.¹⁰ Case counts such as these are useful as a start, but more detailed information is required.

A national tracking system is needed to collect information on firearm-related morbidity and mortality. The Fatal Accident Reporting System (FARS), which is managed by the National Highway Traffic Safety Administration, is a possible model for a firearm surveillance reporting system.⁵⁸ FARS has been instrumental in identifying patterns of motor vehicle-related death and injury. It has been used to evaluate seatbelt laws and to identify trends in motor vehicle-related fatalities after speed limit changes.⁵⁹⁻⁶² A national firearm reporting system could similarly help provide information to lead to policies to prevent firearm deaths.

Firearm injury-tracking data for nonfatal injuries are collected by some local and state agencies, usually police and trauma systems; there is a small but growing number of health department data systems.⁶³ Police reports focus on crime, and trauma registries are limited to patients admitted for hospital care in trauma centers. More comprehensive local data about firearm injuries and deaths are needed for the design and evaluation of local interventions. The problems of rural and urban areas are different; data from each are probably not generalizable to the other.^{64,65}

Figure 1.

International comparison of homicide rates, males aged 15 to 24 years, 1988–1991.

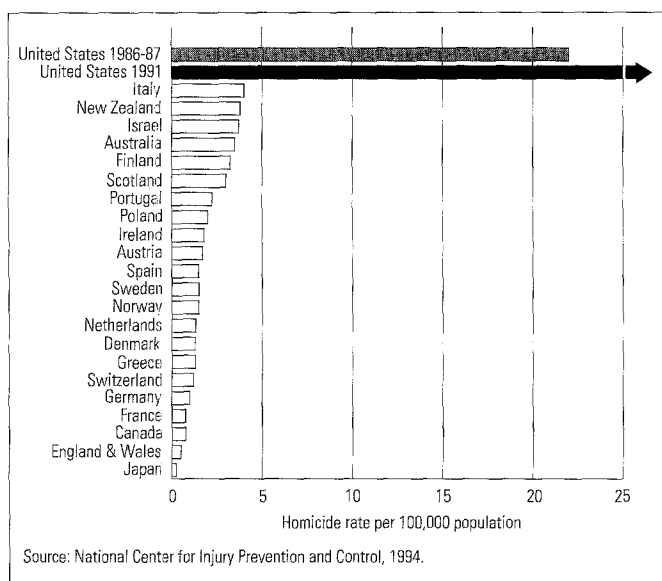
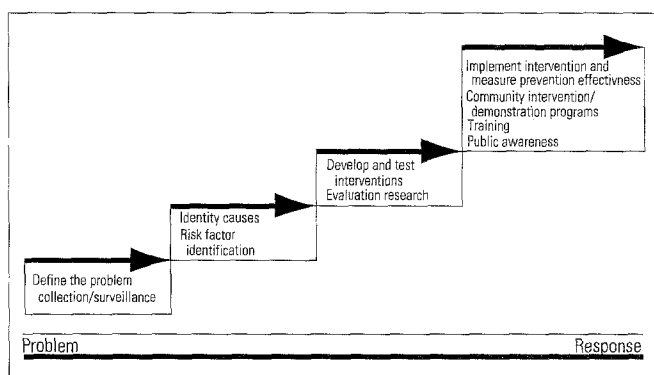


Figure 2.

Public health model of a scientific approach to prevention.



National data are needed to monitor trends in firearm injuries and fatalities.

Any firearm injury-tracking system must be population based and should include specific information (Figure 3). It is useful to know details of the injury event, the relationship between the victim and the offender, and whether the victim or the offender was impaired by drugs or alcohol or had emotional or mental problems. Both the place (home, street, school) and geographic location (census tract) of injury should be recorded. Demographic and socioeconomic information about the victim and the offender are needed, as are data about involvement of medical services and health outcomes. Weapon and bullet information should be documented.⁶⁶ Detailed information will allow informed gun policy decisions; it will also aid in the determination of circumstantial risk factors.^{10,58}

Prevention of violent injury requires the identification of demographic, behavioral, and environmental risk factors. This identification can be performed with epidemiologic methods including rate calculations, cohort studies, and case-control studies. In this step, the intent is to ascertain why a group is at high risk for violent injury so that an appropriate intervention can be developed. We must go beyond identifying risk to examining mechanisms of risk. Although it has been observed that violent events are more prevalent in poor urban neighborhoods, the specific characteristics that make these areas violent are less clear. Black race is a risk factor for firearm homicide. However, some of the rate variation among races is heavily confounded by socioeconomic status. For example, it

Figure 3.

Firearm injury-tracking system.

Injury event

Crime-related: drugs, robbery
Gang-related
Drive-by shooting
Domestic abuse
Suicide
Unintentional firearm discharge

Victim-offender relationship

Alcohol, drugs, mental health factors

Place of injury: home, school, workplace, street

Geographic location: street address, rural coordinates

Demographic/socioeconomic (victim and offender)

Age, race, sex
Education, occupation, employment status, income

Firearm type, make, model, serial number, ammunition used

Medical services involvement

Length and cost of hospitalization/rehabilitation
Impairment in function, duration

has been reported that differences in homicide rates among black and white victims of intraracial domestic violence are accounted for by socioeconomic status rather than by race.⁶⁷ Alcohol use is assumed to be a risk factor for violent injury, yet evidence of a cause-and-effect relationship is limited. Further research and accurate "stories" of causal sequences are needed.

One risk factor for violent death that has been identified is firearm ownership. Although many people keep firearms in the home for protection, it has been shown that the presence of one or more guns in an urban home is associated with increased risk of suicide²⁴ and homicide.²¹ Victims of domestic violence are 12 times more likely to be killed in a firearm-associated assault than in a non-firearm-associated assault.⁶⁸ Evidence also suggests that firearms in the home are of limited usefulness during a burglary.⁶⁹

Development and testing of interventions to reduce violent injury are part of the public health model. Defined methods of analysis include observational studies, prospective randomized trials, population comparisons for occurrences of health outcomes, and time series analysis of trends.⁵⁷ We will outline strategies focused specifically on reducing the burden of gun violence.

The fourth step, clearly on a continuum with the third, involves implementation of interventions and measurement of their effectiveness. The importance of evaluation of interventions cannot be overemphasized; good intentions and creative strategies do not ensure the success of an intervention.

Because of the relationship between handgun access and violent death and injury, reduced access to handguns is seen as a key intervention in controlling the public health epidemic of firearm injury and death. Reduced access must be linked to efforts to address the root causes of violence. We will discuss interventions aimed at reducing firearm violence through altered firearm use, restriction of firearm users, reduced firearm lethality, and reduced firearm numbers.^{56,70}

Ideas to change firearm use are shown in Figure 4. These ideas include regulations prohibiting high-risk activities such as carrying a firearm in a motor vehicle, concealing a weapon on one's person, or firing a weapon in a populated areas.⁵⁶ Limited evaluation of carry restrictions shows that these restrictions reduce gun violence.⁷¹ Particularly stiff penalties for felony gun use attempt to deter firearm use in crimes. These laws have been shown to reduce gun-related crime by a small amount.⁵⁶ The usefulness of metal detectors in community settings such as schools has not yet been evaluated. Laws holding owners

liable for firearm injuries or damage appear logical, but studies of efficacy are needed.⁷⁰

Public education could be directed at teaching safe gun storage and use and increasing public awareness about the risks of having a handgun in the home. There are an estimated 200 million firearms, including 49 million handguns, in US homes.^{71,72} People keep loaded handguns because they believe guns promote home safety. Gun owners must be made aware of the risks of injury posed by loaded handguns to unsupervised children. Public education to teach safe gun use and storage has not been evaluated; safe gun storage requires repeated "safety behaviors" such as unloading and locking up the gun. No data suggest this is a realistic expectation, and some provide reason to believe it is not.^{73,74} Programs teaching the use of firearms for self-defense have not been found to be effective, but analysis is limited.⁷⁰

Restrictions on firearm users could be altered with licensing requirements, waiting periods, specific restrictions on firearm sales to high-risk purchasers, and disruption of illegal markets. The intent of this strategy is to deny firearms to high-risk users, those likely to use firearms to harm society. Handguns are the weapon of choice among inner-city teens, and teens report they can acquire handguns easily.^{12,44} The Brady Law requires a national 5-day waiting period and background check before the purchase of any gun. It has been shown that enforcement of the Brady Law has prevented handgun purchases by felons and those considered "mentally unfit," however, the effect of this legislation on firearm injury rates is still unclear.⁷⁵ An evaluation of the Federal Gun Control Act of 1968, which prohibits gun dealers from selling firearms to "dangerous" persons, showed this law had no significant effect on firearm injuries or deaths.⁷⁰ Many firearms change hands through private transactions; criminals can acquire guns through private purchase or by theft.

Modification of the design of firearms to reduce the risk of accidental discharge is an attractive approach to preventing firearm injury. Although prevention of injuries caused by long guns should not be ignored, it makes sense to focus prevention on the handgun, the agent of most firearm deaths.⁵⁶ Proposals include firearm personalization, the use of computer technology to restrict use to authorized persons, safety devices to make guns inoperable by children, and devices to show the user whether a firearm is loaded.⁷⁶ Although it is certain that computer technologies to personalize firearms could be developed, it is less clear whether this intervention could be designed to resist resetting, whether the public would accept the cost of these weapons, or whether design modification

would be successful in preventing injuries from handguns, objects designed to kill. Firearm childproofing with a simple, strength-based approach is of limited effectiveness.⁷⁷ Safety devices to allow an owner to determine easily whether a firearm is loaded are required on imported weapons; it makes sense to include these features on domestic weapons and to document the effects on injuries and deaths. It is even more likely that design modification strategies would be useful in preventing less frequent but more often unintentional injuries from long guns, the primary purposes of which are hunting and target shooting, not killing people in civilian settings.⁷⁸

A third approach to decreasing firearm injury is the reduction of firearm lethality. Semiautomatic "assault" weapons are particularly lethal. The semiautomatic firing mechanism allows rapid, sustained firing until the magazine, which usually holds approximately 20 bullets, is emptied. These weapons have been banned from importation into the United States since 1989; recent congressional legislation has banned several domestically produced weapons of this type. There are no generally accepted estimates of the lethality of assault weapons compared with other weapons, their uses in crime, or the number of assault weapons in the United States; in 1988, 8.1% of the gun traces for homicides were assault-style weapons.⁷⁹ In-

Figure 4.

Interventions to reduce firearm violence.

Firearm use

- Restriction of carrying in public places
- Increased punishment for felony gun use
 - Greater probability of sentence
 - Longer sentence
- Firearm detectors
- Owner liability for harm to others caused by firearms
- Public education
 - Safe storage and use of firearms
 - Firearm use in self-defense

Firearm users

- Licensing of owners
- Waiting periods (Brady Law)
- Restriction of sales to those at high risk
- Disruption of illegal markets
- Technology to "individualize" firearms

Firearm lethality

- Design
 - Barrel length
 - Magazine size ("assault" weapons)
- Ban on dangerous ammunition

Number of firearms

- Restrictive licensing
- Increased taxes
- Restriction of imports and domestic manufacture

formation about assault weapons, although limited, implies they are involved in a minority of homicides; thus legislation banning their manufacture is not likely to significantly decrease the number of firearm injury deaths. Also, enforcement will require identification and restrictions of illegal markets.

Ammunition modification also has potential as a means of reducing firearm injury lethality. Bullets with full metal jackets are more likely to exit the victim, and their potential for tissue destruction is reduced. However, they increase risk to those nearby. Some bullets marketed in the United States contain large quantities of gunpowder and deformable tips, characteristics that maximize tissue destruction. Regulation of the bullet-manufacturing process might reduce the lethality of firearm injuries.

The number of firearms could be altered by means of effects on both supply and demand, including restrictive licensing of gun dealers, increased taxes on purchases, manufacturing and import restrictions, and public education to decrease demand. From 1975 through 1991, the number of licensed firearms dealers increased by more than 95,000; by 1994, there were over 255,000 dealers.^{80,81} The license applicant must complete a two-page form and answer questions about citizenship, criminal record, and mental health. Licensed firearm dealers can obtain firearms through the mail and sell them to the public. The Bureau of Alcohol, Tobacco, and Firearms performs compliance inspections of firearm dealers; they inspected 4% of firearm dealerships in 1991.⁸⁰ Restrictive licensing would allow more comprehensive supervision of firearm dealers, with the intent of eliminating illegal activities. Increased taxation is another approach to reducing firearm purchases.⁸² Import restrictions on firearms were addressed in the gun control acts of 1968, which banned the importation of cheap handguns, and 1989, which banned semiautomatic assault-style weapons. The manufacture of handguns by American companies has increased dramatically in the absence of foreign competition. This source is currently not regulated.⁸³

Comprehensive efforts to reduce violent death and injury will require enormous investment of energy and money. Physicians who care for victims of firearm violence in the emergency department can assist by recording specific information about the circumstances of the injury so that tracking information is accurate. They can also help educate others about the human cost of firearm violence and participate in legislative efforts to reverse the upward trend of firearm injuries and deaths.

Given its prevalence and high morbidity, we know too little about firearm violence. A public health approach

provides a relatively new framework for the development of solutions. We must evaluate each intervention and acknowledge that not all new strategies will be successful. We must focus on both the agent—the firearm—and the root causes—social, environmental, and behavioral—of the epidemic. We must have patience and perseverance when change feels slow. We must remain dedicated and optimistic. Our children deserve no less.

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